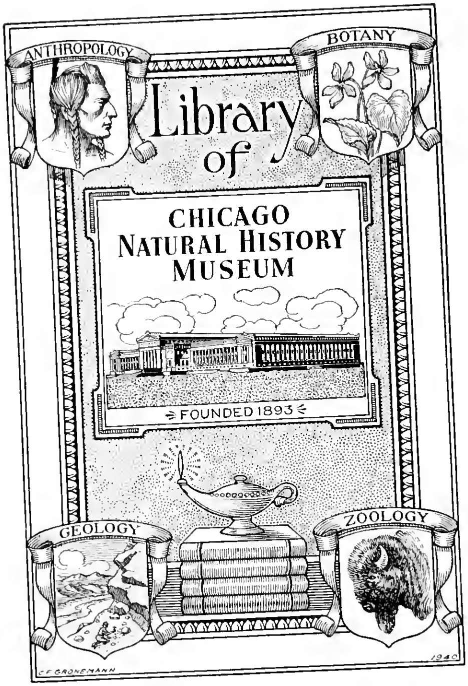
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THE VERTEBRATE FAUNA OF THE SELMA FORMATION OF ALABAMA

PART I. INTRODUCTION

RAINER ZANGERL
CURATOR OF FOSSIL REPTILES

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PREFACE

In the summer of 1945, Mr. C. M. Barber, well known to the staff of this Museum for his untiring search for fossils in the late Cretaceous deposits of Arkansas, decided to make a reconnaissance trip for the purpose of investigating the late Cretaceous deposits of Georgia. Mr. Barber, *mente et malleo*, left for Georgia, only to find that outcrops were few, were scattered along river channels, and consisted mostly of vertical banks difficult to explore. He correctly concluded that younger paleontologists should examine these deposits, and decided to investigate possible outcrops, more nearly resembling those of Arkansas, in the neighboring state of Alabama. A trip to the vicinity of Eutaw resulted not only in the location of some outcrops of the lower, marly member of the Selma formation, but also in the discovery of a number of fragmentary fossil turtles and fish.

Lack of adequate field equipment brought our enthusiastic collector back to the Museum, where he demonstrated his finds. These were fragmentary, but the bones were surprisingly well preserved and it seemed probable that a better equipped field party would obtain more complete materials. Although rather late in the season, it was decided that Mr. Barber, accompanied by Mrs. A. Zangerl and me, should return to Alabama for further reconnaissance. As a result of this trip, outcrop areas were found not only in the vicinity of Eutaw, but also, and to a much greater extent, farther east; a large eroded area was found southeast of Marion Junction.

Many highly interesting vertebrates were discovered and collected in spite of rather unfavorable weather conditions. The rains, after about a month's work, forced us to discontinue the search before all of the outcrop area could be looked over.

A second party was organized in May, 1946, during which time all of the exposures known to us were visited. The party consisted of Mr. Barber and me, accompanied by Mr. William D. Turnbull. About 220 specimens were collected by the two expeditions. Most of them are fragmentary, some scarcely worth preserving; but a few are excellent. Since, to my knowledge, no one had previously undertaken systematic collecting in this formation, it was decided that every fragment we discovered, regardless of how insignificant it might appear, should be carefully collected. This rule paid great dividends, because many fragmentary finds indicate the presence of forms that should be especially looked for in the future. The collection thus presents a fair picture of the vertebrate

fauna populating the shore line at the time of the deposition of the marls, even though many of the faunal elements are at this time inadequately known.[1]

I take this opportunity to express my gratitude to Mr. Barber, through whose initiative this project was undertaken, and to my wife and Mr. Turnbull, both of whom are excellent field workers. The success of the field work was due also to the kind co-operation of the farmers on whose land the fossils were collected. We wish to thank Mr. A. C. Moore, Mr. A. H. Moore, Mr. Charles Potter, Mr. Hancock, and Mr. Henry Stubbs, of Marion Junction; Dr. D. C. Donald, of Selma; Mrs. Crawford and sons, of Cedarville; Mr. Landis Brown, of Eutaw; and many others who helped us in one way or another.

A word of sincere appreciation is due Colonel Clifford C. Gregg, the Director of Chicago Natural History Museum, for his speedy and whole-hearted approval of the project.

RAINER ZANGERL

[1] Since this was written, Mr. Barber has revisited the Marion Junction area and has investigated the possibilities northwest of Eutaw.

CONTENTS

LIST OF ILLUSTRATIONS

PLATES

TEXT FIGURES

Introduction

GEOGRAPHY AND GEOLOGY OF REGION

The Selma formation[1] in Alabama, which forms the so-called Black Prairie Belt across the central part of the state (fig. 1), extends mainly across the following counties: Pickens, Greene, Sumter, Hale, Perry, Marengo, Dallas, Lowndes, Montgomery, Macon, Bullock and Russell. The outcrop area is about twenty-five miles wide, and the formation is more than 600 feet thick. The Selma beds consist of a lower, marly member about 250 feet thick, conformably overlain by a cuesta forming the Arcola limestone member. This relatively thin division consists of two or more hard limestone banks separated by thin layers of marl. The upper division of the Selma, the Demopolis member, rests disconformably on the Arcola limestone (Monroe, 1941). All of the fossils were obtained from the lower, marly portion of the formation. The outcrop area of this lower Selma could be described as gently rolling prairie land. The marls are generally covered by a relatively thick layer of black soil, the Houston clay of the pedologists. This black soil tends to wash off, exposing the soft marls below, which in turn soon form Bad land areas. The rate of erosion seems quite high (about 1½ inches of eroded surface marl were carried off between November, 1945, and May, 1946, according to our observations), but this threat to the future agricultural productivity of the region is largely being met by contour-plowing. Gullies are, therefore, not found on well-kept farms where this plowing technique is used, but rather in the forested places that have been too extensively cut over. The tree that seems to be most capable of living under such poor soil conditions is the cedar. Stands of cedar almost always indicate the presence of marl outcrops.

Fresh marl has a fairly dark, greenish-gray color. When exposed, it becomes bluish-gray. The marl below the top soil is weathered, however, to a varying depth (3–6 or more feet) and its color is a light brown or cream. In sizable exposures, therefore, the marls in the deeper gullies are bluish and those along the edges brown, with the weathering line distinct.

The lower, marly member of the Selma formation is considered to be equivalent to the upper part of the Tokio formation, the Brownstown marl, the Ozan formation, and possibly the base of the Anona chalk of Arkansas; and to the upper part of the Austin chalk and the lower portion of the Taylor marl of Texas

[1] The name was proposed by Smith, Johnson and Langdon (1894) to replace the previously used "Rotten limestone."

(Stephenson and others, 1942). Pertinent parts of the correlation chart (op. cit.) are here reproduced (fig. 2).

The lower, marly member of the Selma formation is perhaps in part of latest Niobrara, but is mostly of early Pierre age (fig. 2). The Brownstown marl of Arkansas appears to be equivalent to the lower half of the marly member of the Selma (fig. 2), whereas the Marlbrook marl in Arkansas is considered to be about equivalent to the Demopolis. The Arkansas-Alabama correlation is here particularly mentioned because both the Marlbrook marl and the Brownstown marl have furnished turtle materials that need to be carefully compared with the Alabama finds. The stratigraphic position of the New Jersey Greensand forms remains doubtful, since it is not known exactly from which levels of the marl pits they have come, and deposits now considered as Eocene (Cooke and Stephenson, 1928) are found together with late Cretaceous sediments in the same pits.

Fossil Localities

The outcrops at which remains of fossil vertebrates were collected by the two field parties of Chicago Museum in 1945 and 1946 are located between the towns of Eutaw in the west and Selma in the east. A number of localities were found in the vicinity of Eutaw in pastures about three miles south of the town, mostly on the properties of Mr. Landis Brown and Mr. Banks. All of these outcrops are small exposures, scattered over about a square mile of forested land. The gullies are shallow and can be found only by walking back and forth through the woods. Almost all of these exposures are fossiliferous. More important outcrops occur east of the Black Warrior River, and a number of fine exposures were found along the west side of Alabama Highway 13, north of U. S. Highway 80 and south of Greensboro. The southernmost exposure is located on the Crawford farm. It consists of two areas, one almost adjoining the other. The westernmost gullies are the most fossiliferous. Five miles north of Crawford farm, along Highway 13, is another extensive patch of gullies, not directly visible from the road but unmistakably indicated by a good stand of cedar. This area is located in Township 19 N., Range 4 E., section 11, Hale County. Between the Crawford farm and the latter locality there are small gullies all along the road; in one of these, situated in section 28, in the same township, in Hale County, a turtle was found.

The most significant outcrop region, however, was discovered in Dallas County, southeast of Marion Junction (pl. 3), about ten miles west of Selma. In the vicinity of Harrell Station, one mile east of Marion Junction, U.S. Highway 80 and the Southern Railroad run close together and almost parallel to each other for a short distance. East of the station, between the highway and the track, there are two small fossiliferous exposures in a pasture of the Potter farm. Running at a right angle to U.S. Highway 80 and the railroad track at Harrell Station is the Cahaba Road (Old Indian Trail Road) connecting the town of Marion in the north with Hazen to the south. It is along this road, about one and one-half miles south of Harrell Station, that a small, unimproved

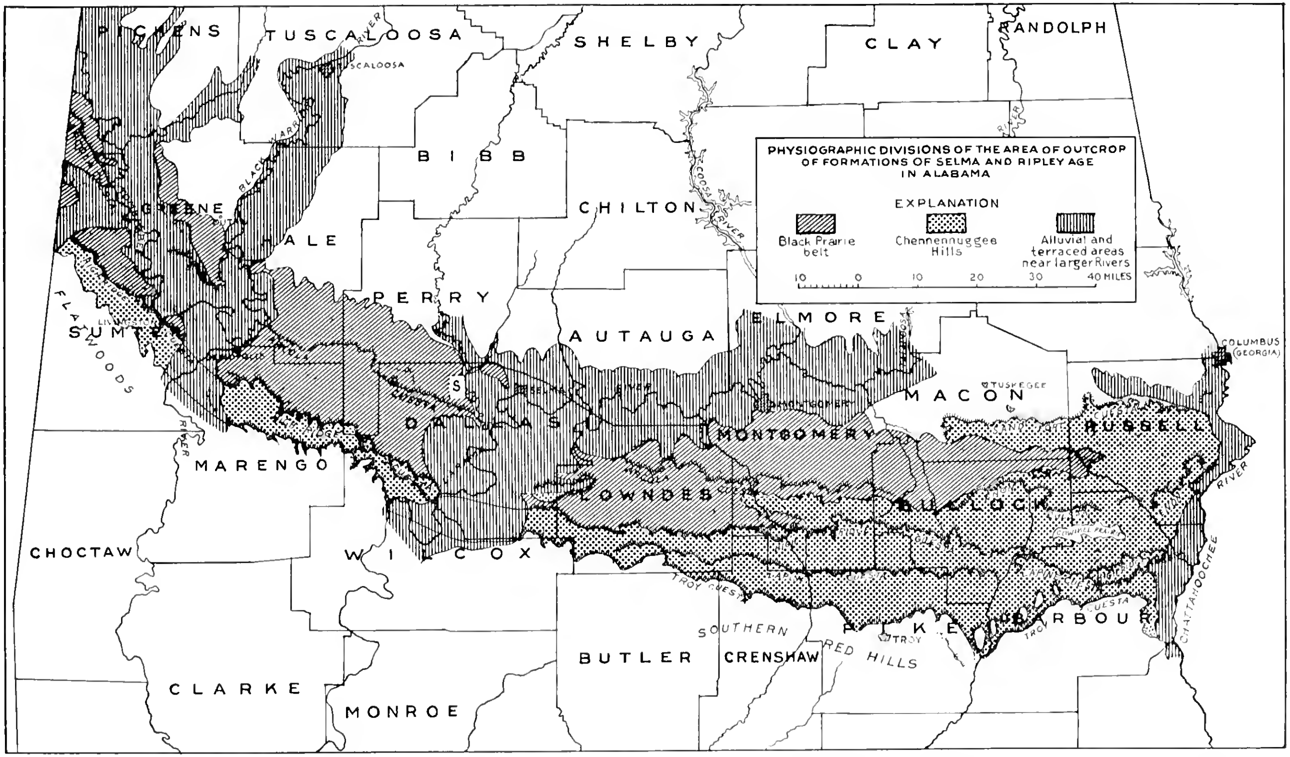

FIG. 1. Map showing outcrop area of Selma formation in Alabama. White square, labeled "S," gives location of the aerial map (pl. 3). After Monroe, 1941.

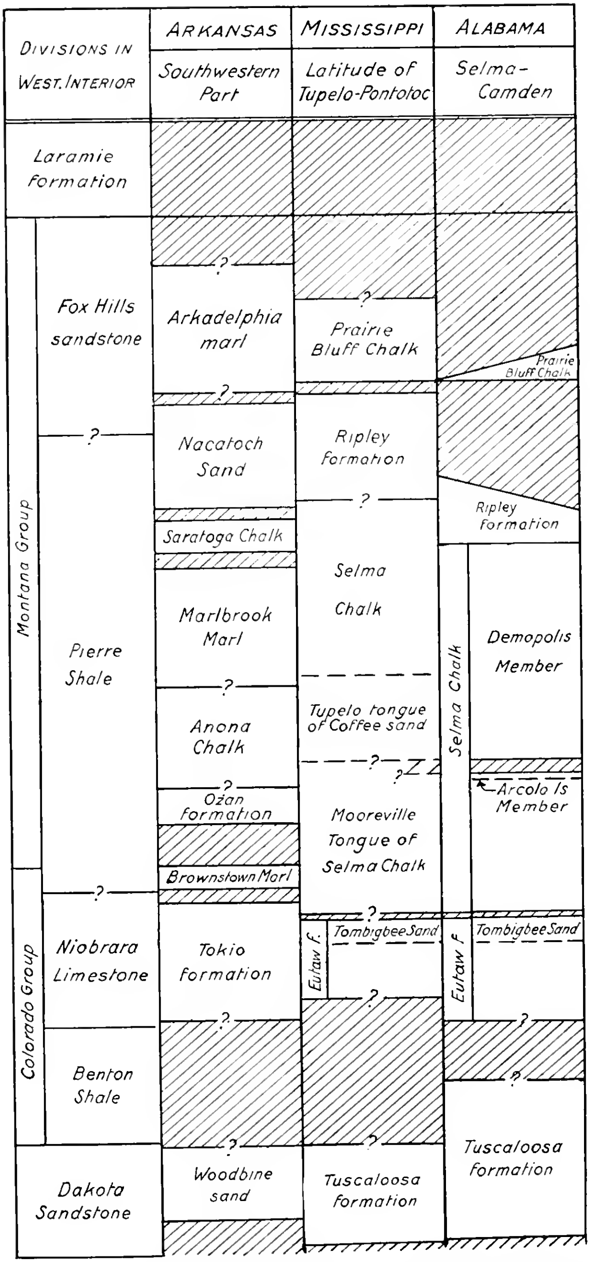

FIG. 2. Late Cretaceous deposits in Alabama (Selma-Camden), Mississippi (latitude of Tupelo-Pontotoc), and Arkansas (southwestern part) correlated with generalized, standard divisions in western interior. From Stephenson and others, 1942.

road leads east to a large complex of exposures located on part of the Moore Brothers' and Dr. Donald's farms (pl. 3). This wooded, hilly area contains a great many pockets of varying dimensions that are not uniformly fossiliferous. Some of these were full of fossil remains; others proved poor or virtually non-fossiliferous, although the marls themselves were very uniform in character all through the region. A stratigraphic subdivision of these marls, therefore, could not be attempted.

Fossil Content

A preliminary survey of the fossils collected reveals an abundance of turtle remains, some belonging to the highly specialized, aquatic families Protostegidae and Toxochelyidae, others to the family Pelomedusidae. At the present time the Pelomedusidae are fresh-water forms, but they seem to have inhabited the shore lines of the shallow Cretaceous sea. The possibility that these forms might have been washed into the marine sediments from fresh-water pools or streams appears unlikely, since remains of this turtle are too numerous to suggest accidental inclusion, and since a very similar form was described from the Brownstown marl of Arkansas (Schmidt, 1940). Besides turtles, a partial skeleton of a small hadrosaurian dinosaur and a single, isolated phalanx of a probable ornithomimid dinosaur were collected. Small mosasaurs of the *Clidastes* type are numerous, whereas remains of large forms are rare.

Remains of elasmobranchs and of teleost fishes are commonly found, and among the latter there are some very large species.

The collection, furthermore, includes a number of problematica.

Fossil plants are numerous, but almost always very poorly preserved. A noteworthy exception is a beautifully preserved cone of a small conifer. Thick-shelled mollusks—for example, oysters—are relatively uncommon in the marl beds in which these collections were made, but there are many thin-shelled forms, some reaching very large size.

Condition of Preservation of Bones

On the whole, the vertebrates of the lower Selma marls are well preserved; solid bones with good surface texture are common. Often the bones are uncrushed, and microscopic examination reveals that the bone cavities are filled with either calcite or bitumen. The bony trabeculae, in such cases, have not been distorted (pl. 1, fig. 1). More often, however, the bones did suffer some distortion and/or crushing, although the amount of both kinds of deformation is far less than in specimens from the Niobrara chalk of Kansas.

Distortion is the more troublesome of the two types of deformation; minor distortions can scarcely be recognized on the basis of surface appearance, which, in such bones, seems perfectly normal. In the case of crushed bones, it is often possible to estimate the amount of crushing that took place (pl. 1, fig. 2). Crushing, in bones from the Selma marls, seems to be due to collapse of areas in the

interior that became only partially filled with minerals. A thin ground section through a peripheral plate of a turtle shell (pl. 1, fig. 2) shows that the large central vacuities of the outer uncrushed half of the plate are filled throughout with calcite, but in the inner half of the bone only part of the cavities are mineralized. The dark area in the middle consists of broken trabeculae with small grains of mineral mixed in. The microscopic picture of this bone strongly suggests that the crushing is due to moderate pressure long after the process of fossilization had been completed, and that only those bones in which the cavities did not become completely mineralized are affected (pl. 1, figs. 1, 2).

Occasionally, bones are impregnated with pyrite. Pyrite, like calcite or bitumen, fills the bone cavities, apparently without destroying or significantly altering the microscopic structure (pl. 1, fig. 3). Pyritic bones tend to disintegrate, and often cannot be preserved.

Conditions of Burial and Deposition

Whole, articulated skeletons were not observed, but articulated portions of partial specimens do occur. As a rule, the remains of an individual are scattered, often over an area several times the size of the animal. Well-preserved individual bones are common. Rarely, sessile invertebrates are attached to plates of turtle shells, both on the inner and outer (horn-covered) surfaces; for example, a bryozoan colony, *Membranipora* sp.[1] (pl. 2), is situated on the outer face of the seventh right costal plate of a specimen of *Podocnemis* (P27372), and a fragment of a barnacle(?) is located on the visceral surface of the fourth right costal plate of another specimen of *Podocnemis* (P27369).

All these indications suggest that, in general, the carcasses became disarticulated prior to burial. It is probable that scavengers are responsible for the scattering of the remains in most cases; only rarely could the displacement of the bones be attributed to wave action, such as perhaps in the case of a large protostegid turtle (P27314) in which the bones, although dispersed over an area of about thirty square yards, do not show any signs of scavenger action. In some cases the macerated bones must have lain on the bottom for a considerable length of time before they became embedded, thus enabling sessile invertebrates to use them as bases for attachment.

Stephenson (1926) characterizes the origin of the marl deposits as follows: "The chalk was doubtless formed as calcareous, more or less muddy oozes which gradually accumulated on the bottom of a clear and only moderately deep sea." In discussing the probable depth at which the chalk was deposited Stephenson and Monroe (1940) state: "The chalk was deposited in marine waters less than 100 fathoms deep, probably for the most part less than fifty fathoms deep, as indicated by the presence in many layers, particularly in the less pure facies, of great numbers of large shells of the family, Ostreidae." To this might be added that the marls were probably deposited near shore, in a relatively protected area.

[1] Dr. Bassler of the United States National Museum kindly made a generic determination based on an enlarged photograph of the colony.

EARLIER FINDS OF FOSSIL VERTEBRATES IN SELMA DEPOSITS OF ALABAMA

Seven species of mosasaurs have been described from the Selma formation. Leidy (1851) described a plesiosaur, *Discosaurus vetustus*, and Renger (1935) figures the scapula, arm, and hand of a protostegid turtle and mentions the collection of a sizable portion of the skeleton; at the time of publication it was not fully prepared. A more detailed account of this fossil has not yet been given. The first mosasaur material was described by Gibbes (1851) as *Amphorosteus brumbyi* and *Mosasaurus minor*. Nearly twenty years later three more mosasaurs were added to the list by Cope: *Liodon congrops* and *L. perlatus* (1869a) (both species were subsequently transferred to the genus *Tylosaurus* by Hay, 1902) and *Clidastes propython* (1869b). *Clidastes intermedius* was described by Leidy (1870). Gilmore (1912) established the genus and species *Globidens alabamaensis*. So far as I can discover, no work has been done on the fishes of the Selma marls.

A superficial survey of the present collection shows that turtle remains are the most abundant fossil remains in the Selma marls; then follow fishes and mosasaurs. Dinosaurs appear to be very rare. No traces of plesiosaur material were found, and only one specimen (a partial skeleton), which could possibly be determined as *Globidens alabamaensis* Gilmore.[1] The mosasaur remains appear rather uniform, and probably not more than three species are represented in the collection.

[1] This form is based on a relatively small jaw fragment, so that positive identification of additional finds is very difficult.

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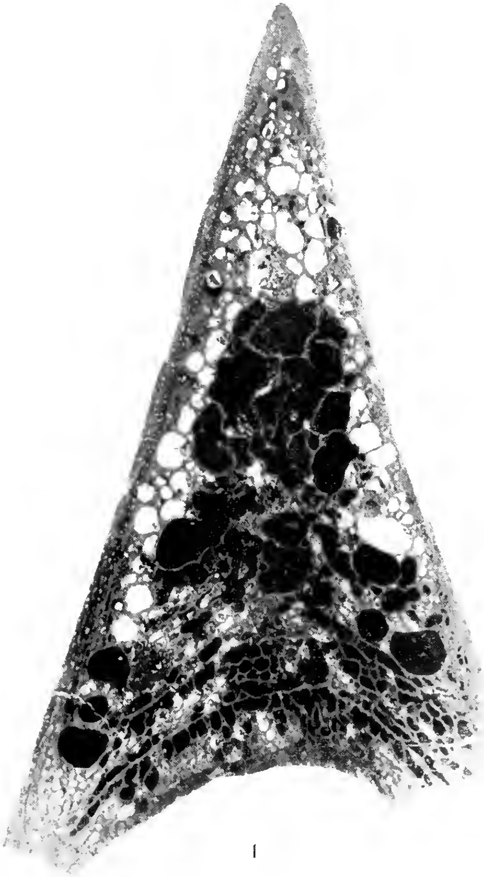
EXPLANATION OF PLATE 1

FIG. 1.—Cross section through an anterior peripheral plate of a turtle (C.N.H.M. P27348) from the Selma marl of Alabama. The specimen is exceptionally well preserved, with the large cavities in the interior of the bone completely filled with bitumen (the dark particles) and calcite (the light cavities). There is no sign of crushing.

FIG. 2.—Cross section through a posterior peripheral plate of a turtle (C.N.H.M. P27358) from the Selma marl of Alabama. In the peripheral portion of the plate the bone cavities are filled with calcite and there is no crushing, whereas in the inner, compressed half of the plate only part of the cavities became filled. The rest collapsed under pressure. The dark streak through the middle of the inner part of the section consists mostly of broken trabeculae mingled with dislocated grains of mineral.

FIG. 3.—Cross section through a pyritized fragment of a limb bone of an undetermined chelonian (P27351).



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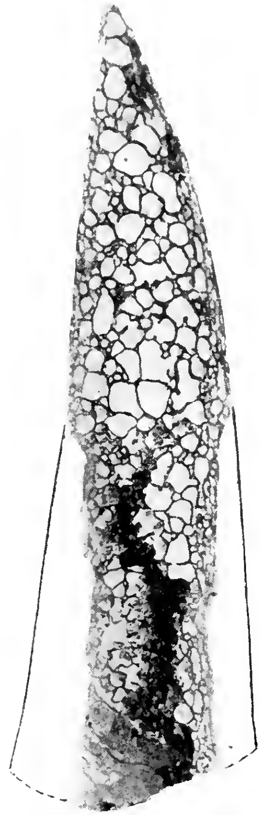

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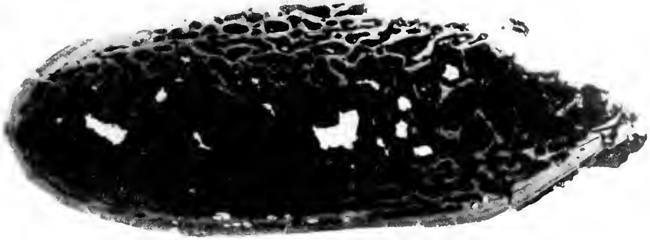

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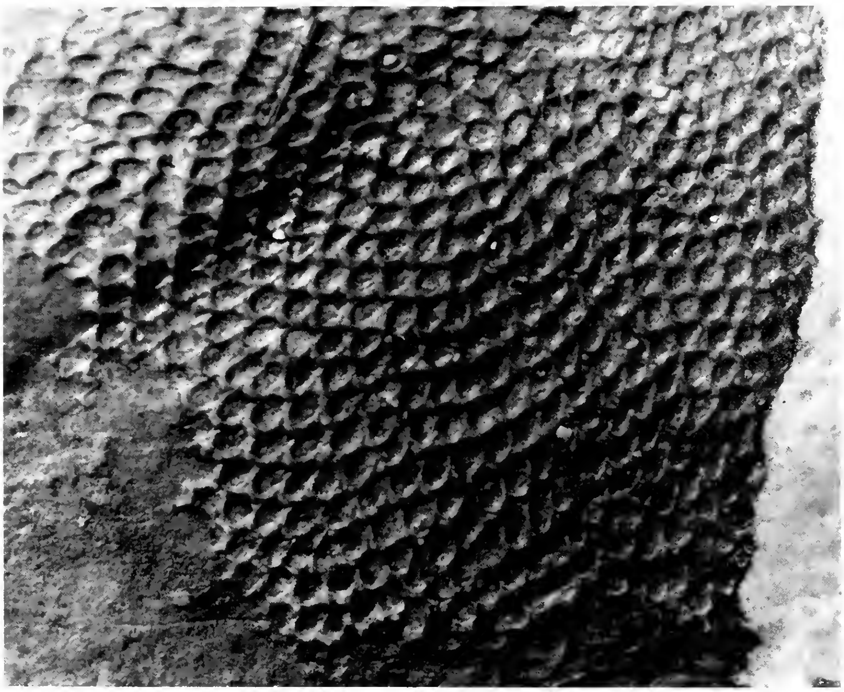
EXPLANATION OF PLATE 2

A colony of *Membranipora* sp. located on the outer surface of the seventh right costal plate of a pleurodire turtle (C.N.H.M. P27372). Photograph greatly enlarged.



EXPLANATION OF PLATE 3

Aerial map of fossil locality, southeast of Marion Junction, Alabama; U. S. Highway 80 runs approximately east–west. Slightly beyond the left margin, near the upper corner of the map, are Harrell Station, on the Southern Railroad, and Marion Junction, Alabama. Fossil locality No. 3 lies in a pasture of the Potter farm. The sites of a few of the more outstanding finds are indicated on the map. Scale about 1:8000.

A. Potter farm
B. Hancock farm
C. Donald farm
D. Moore Brothers farm
E. G. S. Moore farm
F. Henry Stubbs farm

1. Camp site of fall party, 1945.
2. Camp site of spring party, 1946.

Sites of Specimens Collected

2. A probably ornithomimid dinosaur phalanx (P27398).
3. A large fish (P27323).
4. A medium-sized protostegid turtle (P27315).
5. A large-sized protostegid turtle (P27314).
6. A fairly complete turtle shell (P27330).
7. A *Clidastes*-type mosasaur (P27324).
8. A good turtle carapace (P27391).
9. The hadrosaurian dinosaur (P27383).
10. Mosasaur (P27400).
11. Mosasaur (P27399) and shoulder girdle of a protostegid turtle (P27353).
12. A small partial turtle skull (P27338).
13. A larger partial turtle skull (P27337).
14. A small podocnemid turtle (P27372).
15. A good turtle carapace and plastron (P27453).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U.S. HQ
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Indian Trail Road
Old Indian Trail Road
CAHABA RIVER
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